A Research Note

Evaluation of a Food Processor for Making Model Meat Emulsions

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ABSTRACT

Meat emulsions or batters made with a retail food processor were compared to batters produced by three commercial machines (silent cutter, Schnellkutter, and emulsifier) and two laboratory machines (small size cutter and blender) for suitability in laboratory studies. Batters were evaluated for post-heating fat losses and smokehouse water losses. Stabilities of the finished frankfurters were evaluated by severe cooking weight changes, penetration forces, fat droplet sizes, and sensory qualities. The food processor was comparable to the other machines for producing high quality batters and had the advantage of being inexpensive, economical with ingredients, and time-saving.

INTRODUCTION

MODEL SYSTEMS are frequently used to study meat emulsions. One approach has been to study the emulsifying capacity of meats by blending dilute protein extracts with liquid oil (Swift et al., 1961; Carpenter and Saffle, 1964; Webb et al., 1970). Although often used (Saffle, 1968; Webb, 1974), this approach has limited applicability in studying meat emulsions. Differences between this model system and actual meat emulsions include an unrealistically high emulsification capacity by the proteins in the model system, a much lower viscosity of the aqueous phase, the use of a liquid rather than solid lipid phase, and a lack of information on emulsion stability (Saffle, 1968).

Other model systems more closely simulate commercial procedures. Muscle tissue and vegetable oil were emulsified by a blender-mounted apparatus (Haq et al., 1972), and Ockerman and Cahill (1970) designed a small blender with a scraper in the bowl. Morrison et al. (1971) and Lauck (1975) used an Omni-Mixer. Johnson (1976) devised a prototype that incorporated a blender with a plunger to force the ingredients between the blades and through an exit tube. However, these methods were still not as close to commercial methods as desired, did not function well, or required special fabrication of the equipment.

The use of a food processor for making frankfurter batters has the potential for overcoming these objections. It can use the normal ingredients in the usual sequence of cutter steps. In addition, it has many potential advantages that include: being inexpensive, not requiring modification, and being capable of making many batches in a relatively short time. Therefore, we evaluated its batter-making capabilities compared to commercial and laboratory machines for use in meat research.

MATERIALS & METHODS

Materials

Beef round, pork shoulder, and pork adipose tissue were obtained from local processors. Proximate analyses were determined by the dye binding method for protein (Pettinati and Swift, 1976, personal communication) and the Foss-let method for fat (Pettinati and Swift, 1975). Frankfurters were formulated to contain 11% protein, 30% fat, 54% water, 2.51% salt, 1.98% sugar, 1.50% commercial spice mixture, 0.015% $NaNO_2$, and 0.053% ascorbate. The lean meats, salt, sugar, nitrite and ascorbate solutions, and ice were chopped for one-sixth to one-third of the total chopping time before fat was added. Batters were chopped to 15.5°C, stuffed into cellulose casings, and processed in an air conditioned smokehouse with wood smoke to an internal temperature of 71°C. Comparisons were made among the following machines (quantities and total chopping times): Cuisinart CFP-9 food processor (250g, 2 min); Koch-Alpina Pb-50 silent cutter (10 kg, 18.5 min); Stephen-Koch 25L Schnellkutter (7 kg, 5.8 min); Hobart-Stephan micro-cut MCU-12 emulsifier (7.5 kg, prechop 10.2 min in the Koch-Alpina silent cutter, then 1 pass through the emulsifier); Hobart 84145 small silent cutter (2.5 kg, 15.5 min); and Omni-Mixer Servall 485 laboratory blender (250g, 0.5 min). The laboratory blender was modified to allow the metal jar to be moved up and down relative to the blades for improved chopping of the entire sample (Morrison et al., 1971).

Analytical methods

Frankfurter quality was assessed by the fat loss during the emulsion stability test (Meyer et al., 1964), weight loss during processing, severe cook weight change (Tauber and Lloyd, 1947) after 10 min boiling, penetration force of a 6.4 mm plunger moving at 12.7 cm/min into the end of a 2.5 cm cylinder of frankfurter (Whiting et al., 1981), fat droplet size of 80 droplets (min size 25μ diameter) by direct microscopic examination of frankfurter sections stained with Sudan Black (Ackerman et al., 1971), and sensory triangle tests (Roessler et al., 1978; Whiting et al., 1981). The data were analyzed with a one-way analysis of variance and Duncan's multiple range test (Steel and Torrie, 1960).

RESULTS & DISCUSSION

OPERATION of the food processor was similar to the silent cutters. Lean meat was chopped with ice, salt and cure for 45 sec. After addition of fat, the mixture was chopped for an additional 30 sec and the temperature measured. The chopping and temperature measuring were repeated until the desired final temperature was reached. An emulsion could be chopped and the equipment cleaned for reuse in 15 min. Because of the high viscosity of the batters and long chopping times, the food processor should have protection against overheating the motor.

The food processor was capable of making emulsions of varying compositions (Table 1). Differences in smokehouse water losses, Meyer test fat losses, and penetration forces reflected the frankfurter's composition. The average fat droplet sizes and the slight weight gains when severely cooked show the processor's ability to handle reasonable variation. The 44.5% fat frankfurters showed a modest loss in the severe cook test. No fat separation occurred during smokehouse processing of any formulation.

Extending chopping times to reach higher temperatures produced unstable emulsions similar to that reported with larger cutter machines (Acton et al., 1983). Meyer test fat losses and severe cook losses indicated the loss of emulsifying capacity with increasing chopping temperature. Gel strength, as indicated by the penetration force, was slightly affected, and water loss decreased during the smokehouse processing. Although the average fat droplet size decreased,

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Table 1—Characteristics of batters and frankfurters made with a food processor

Treatment	Meyer test fat loss (%)	Smokehouse loss (%)	Severe cook wt change[d] (%)	Penetration force (g)	Average fat droplet size (μ)
Composition					
Low fat 15% protein, 11% fat	0.8[a]	16.8	1.6[c]	836[c]	103[b]
Standard 11% protein, 30% fat	2.0[b]	12.8	1.2[c]	518[b]	109[b]
High fat 9.5% protein, 37% fat	3.3[c]	10.6	0.0[b]	469[b]	106[b]
Very high fat 8% protein, 44.5% fat	2.7[bc]	7.0	-5.4[a]	322[a]	87[a]
Chopping temperature					
15.5°C	2.0[a]	12.8	1.2[a]	518[a]	109[a]
24°C	5.2[b]	11.0	-15.6[b]	455[b]	110[a]
31°C	14.0[c]	7.0	-46.8[c]	440[b]	94[b]

[a-c] Within an experiment, values in each column with the same letters are not significantly different ($p < 0.05$).
[d] Positive values indicate a weight gain, negative values, a weight loss.

Table 2—Comparison of emulsions and frankfurters made by the food processor and commercial or laboratory machines

Machine	Meyer test fat loss (%)	Smokehouse shrinkage (%)	Severe cook wt change[e] (%)	Penetration force (g)	Average fat droplet size (μ)	Triangle test with food processor
Food processor	0.8[a]	11.0	1.2[bcd]	424[a]	120[c]	
Silent cutter	0.7[a]	10.6	-1.4[a]	486[b]	73[a]	26/44***
Schnellkutter	3.3[c]	10.9	1.4[cd]	453[ab]	70[a]	13/24*
Emulsifier	2.0[abc]	10.8	0.4[bc]	450[ab]	83[ab]	14/22**
Small silent cutter	2.6[bc]	11.0	0.3[b]	602[c]	113[c]	—
Laboratory blender	1.5[ab]	12.0	1.7[d]	558[c]	104[bc]	—

[a-d] Values in each column with the same letter are not significantly different ($p < 0.05$).
[e] Positive values indicate a weight gain, negative values a weight loss.
* $p < 0.03$; ** $p < 0.01$; *** $p < 0.001$.

more droplets larger than 200 μ were observed in sausages from the 31°C treatment which Ackerman et al. (1971) showed was indicative of emulsion failure. Extensive fat caps were also observed.

Preparations made in three commercial machines (silent cutter, Schnellkutter, and emulsifier) and two laboratory machines (small silent cutter and blender) were compared with those made in the food processor (Table 2). All batters were of standard composition (11% protein, 30% fat), chopped to 15.5°C, and processed in the smokehouse at the same time. Smokehouse shrinkages of the batters were all similar. The fat losses and severe cook changes showed that a good quality batter could be produced by each machine. Penetration force was lowest and fat droplets largest for the frankfurters made with the food processor, but the values were not significantly different than those from some of the other machines. Connective tissue was visible in the emulsions chopped with the small silent cutter and the laboratory blender and probably caused their high penetration forces. The three laboratory machines had larger fat droplets including a few fat droplets larger than 200 μ in diameter. However, no fat separation was observed in any of the frankfurters.

The triangle tests indicated significant differences in sensory quality among frankfurters made with the food processor and the three commercial type machines, although the portion of correct judgments ranged from only 13 of 24 judgments to 14 of 22 judgments. This demonstrated that even though the franks were not identical, the differences were not of a magnitude that was consistently detected.

In summary, these tests showed that differences existed between batters manufactured by any of the machines. The food processor made a high quality batter and had many advantages for laboratory use.

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Reference to a brand or firm name does not constitute endorsement by the U.S. Dept. of Agriculture over others of a similar nature not mentioned.